Using Models to Test Process Assumptions within the SEL Recommended Software Development Approach

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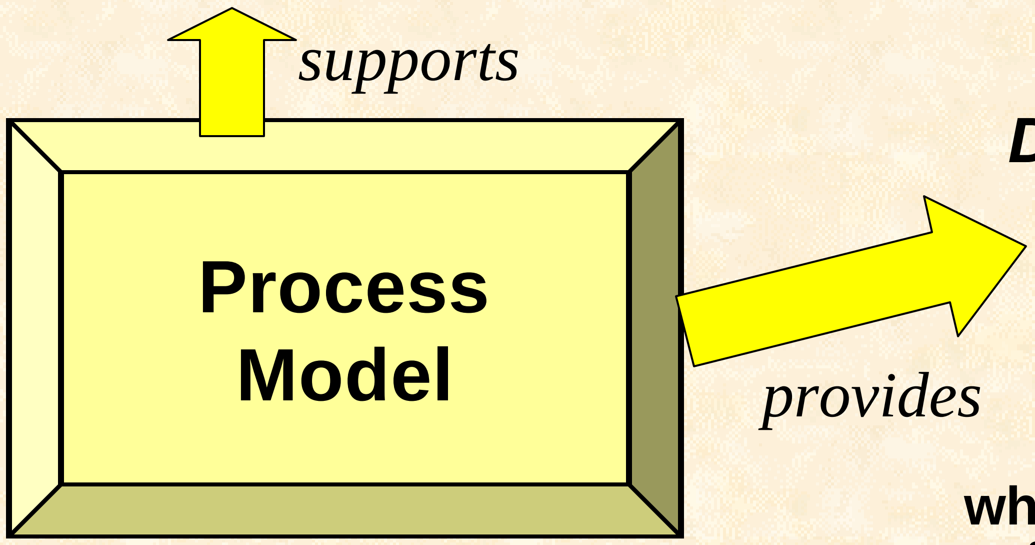
Outline

- **Introduction**
  - Why process modelling, why a hybrid approach, and the suggested approach
- **Building a Process Model**
  - A model of the SEL recommended software development approach
- **Applying the Model**
  - To reproduce some possible software development scenarios

Why Process Modelling

Key objectives of software companies:

- **high quality products**
- **high performance processes**



Dynamic Estimation

Capability

assess and analyse
what-if and off-line analysis
forecast and prototype

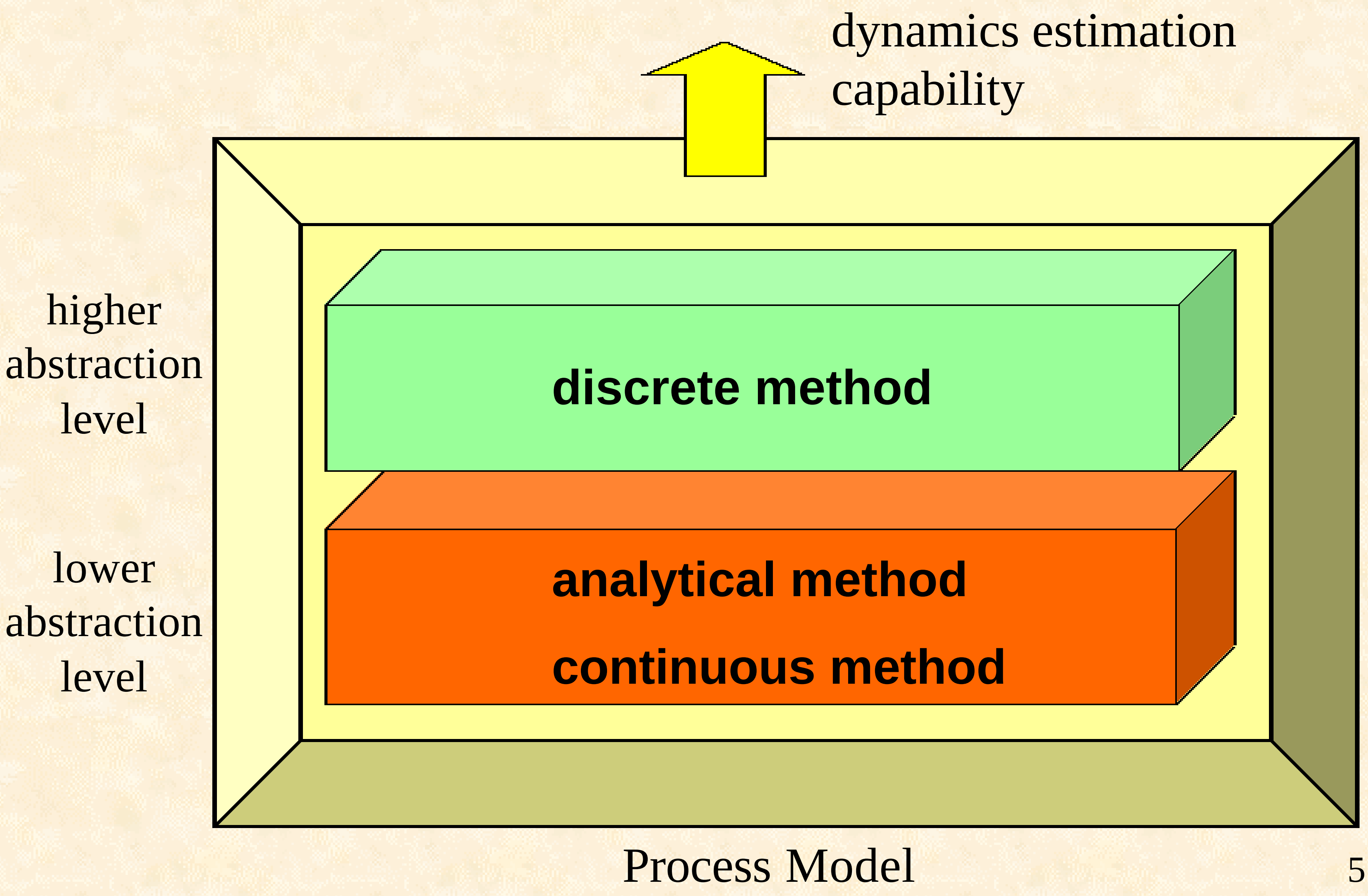
Why a Hybrid Approach

The software process *is composed by various activities*:

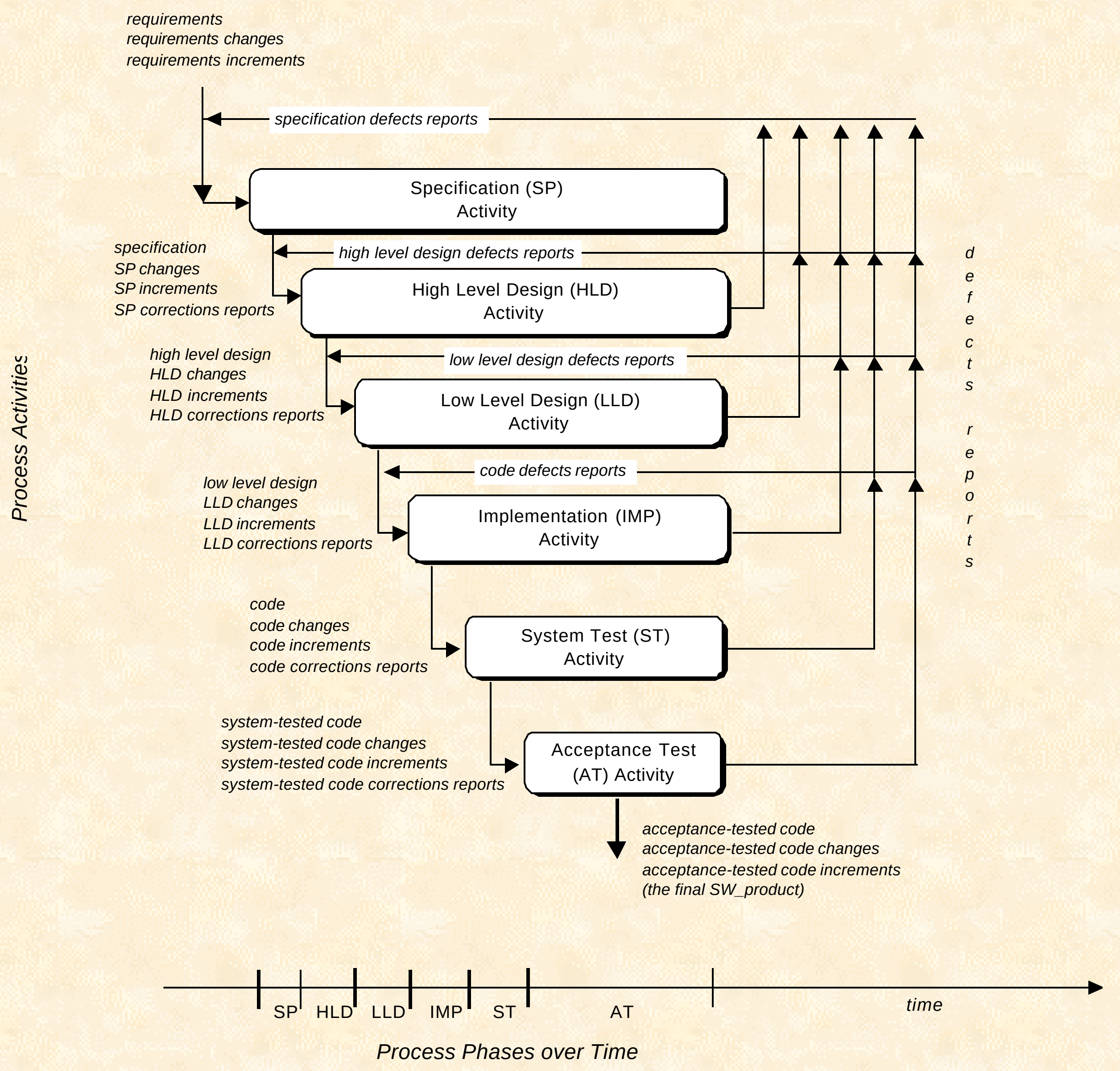
- **some are sequential, others may be performed concurrently**
- **activities exchange artifacts**
- **activities consume resources and may collide**

To model a software process we have to deal with both *discrete system aspects* (start/end of an activity, reception/release of an artifact) and *continuous system aspects* (resource consumption, percentage of developed product).

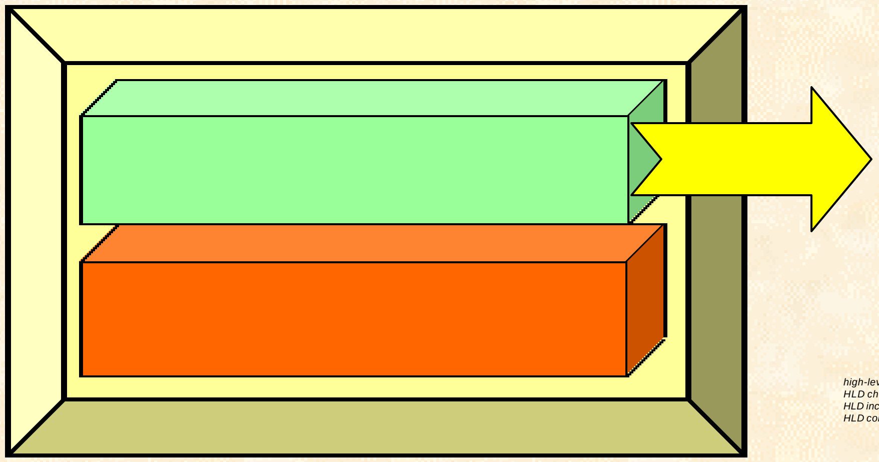
A Hybrid Two-level Modelling Approach



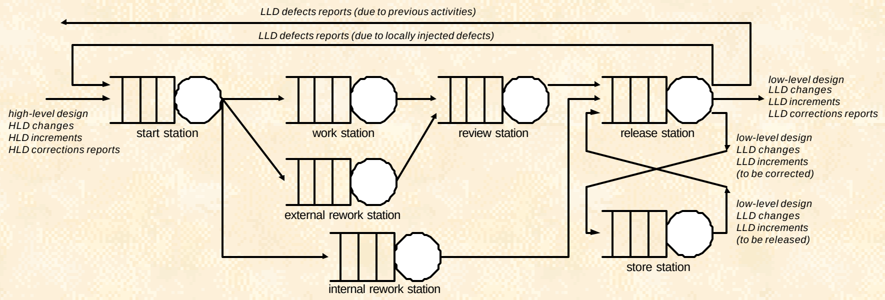
Modelling the SEL Software Process



The Higher Abstraction Level



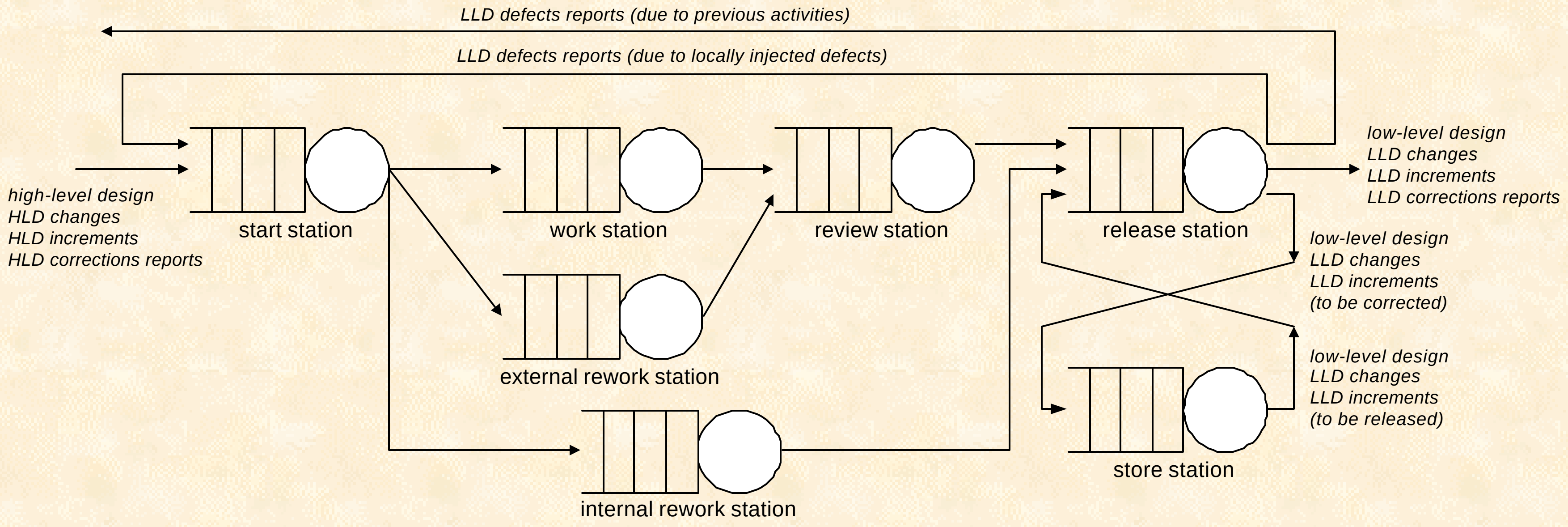
Modelling the process structure



The process is modelled by a <u>discrete-event queue net:</u>

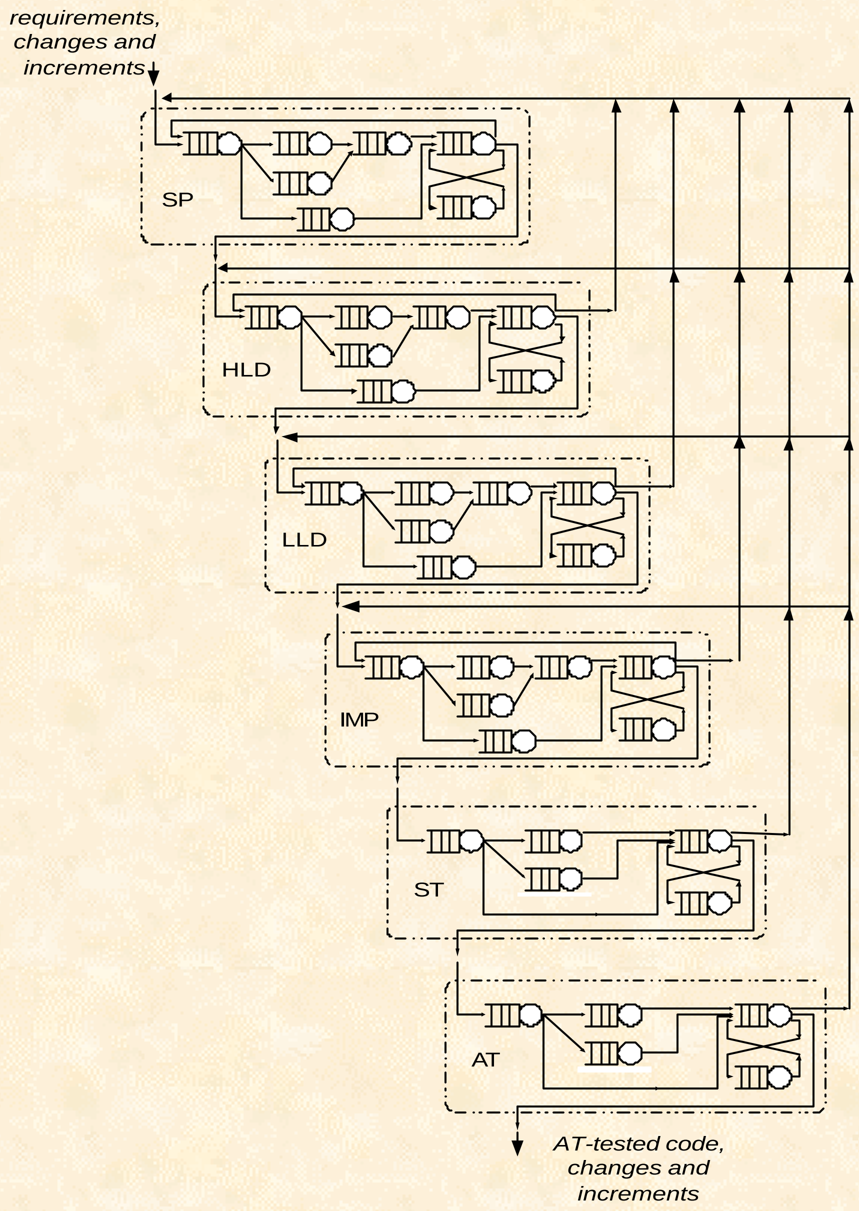
- **activities are networked sets of service stations**
- **artifacts are circulating customers**

Higher Abstraction Level



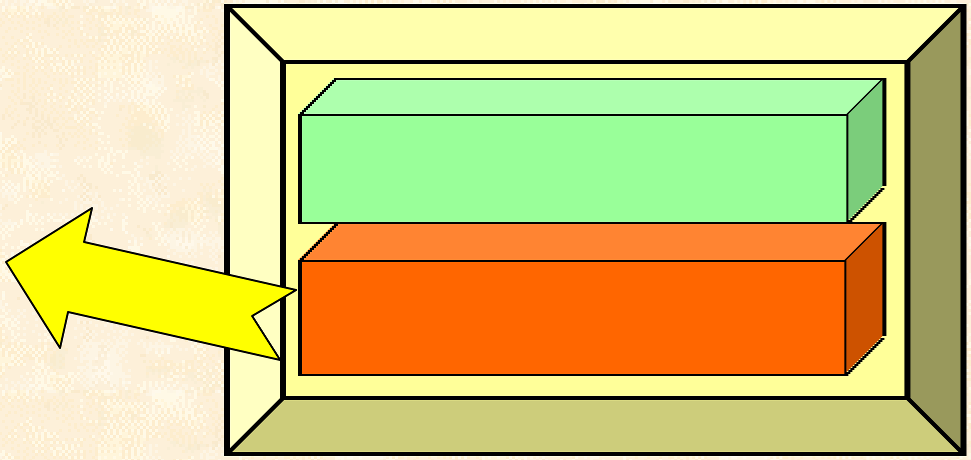
Low-level Design (LLD) Activity

Higher Abstraction Level of the Process


requirements, changes and increments
SP
HLD
LLD
IMP
ST
AT
AT-tested code, changes and increments

The Lower Abstraction Level

Modelling the activities' behaviours



Each activity (service station) is modelled by:

•an analytical average-type function,

•or a continuos type time-varying function,

•or a combination thereof.

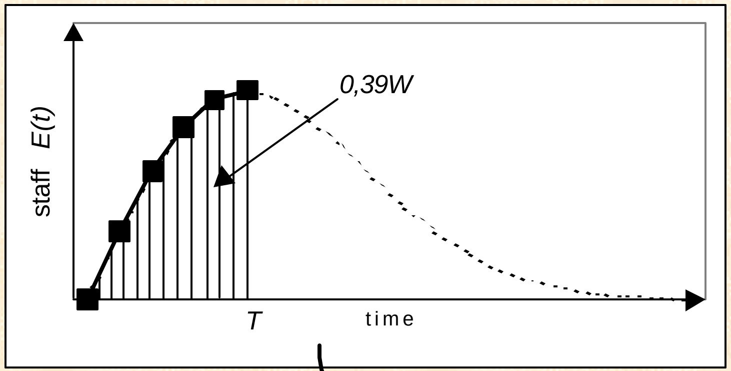
Lower Abstraction Level of the "Work Station"

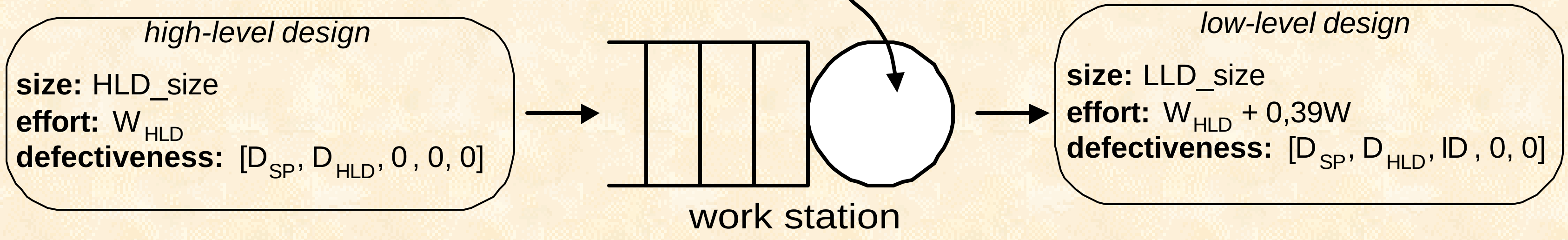
$$LLD\_size = Random(a_1 HLD\_size^{b_1} + c_1)$$

$$T = a_2 LLD\_size^{b_2} + c_2$$

$$W = a_3 LLD\_size^{b3} + c_3$$

$$E(t) = W \frac{t}{T^2} e^{-\frac{t^2}{2T^2}}$$





high-level design

size: HLD_size
effort: W_{HLD}
defectiveness: $[D_{SP}, D_{HLD}, 0, 0, 0]$

low-level design

size: LLD_size
effort: $W_{HLD} + 0{,}39W$
defectiveness: $[D_{SP}, D_{HLD}, lD, 0, 0]$

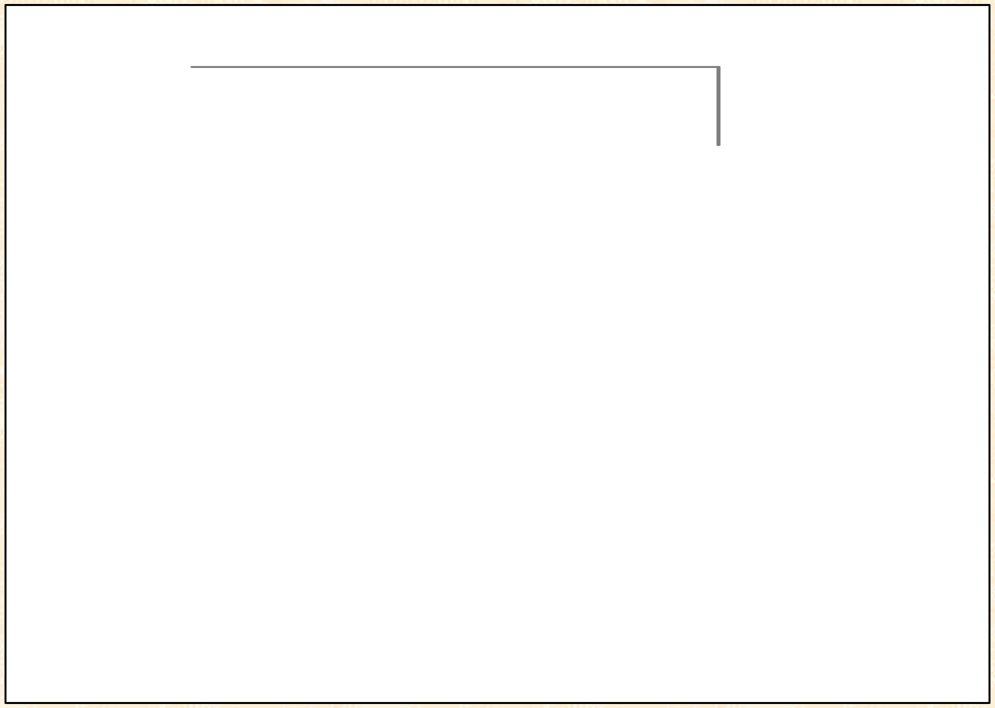
Applying the Model

Two possible software development scenarios are simulated:

- **with <u>stable set of requirements</u> (1500 FPs)**
- **with a certain amount of <u>requirements instability</u>**

The main process attributes are *effort* (W), *delivery time* (T), *productivity* (P), *rework percentage* (RWK), and *product defect density* (DFD).

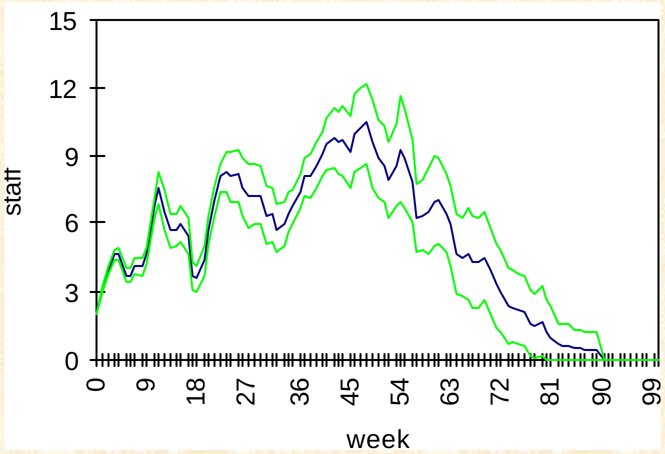
Stable Requirements – Simulation Results

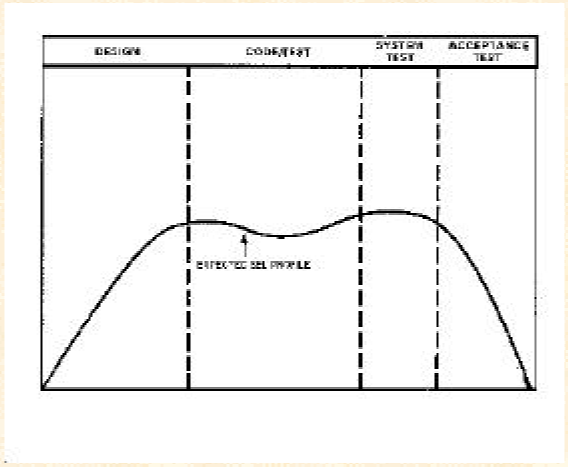


Stable Requirements – Comparison with SEL

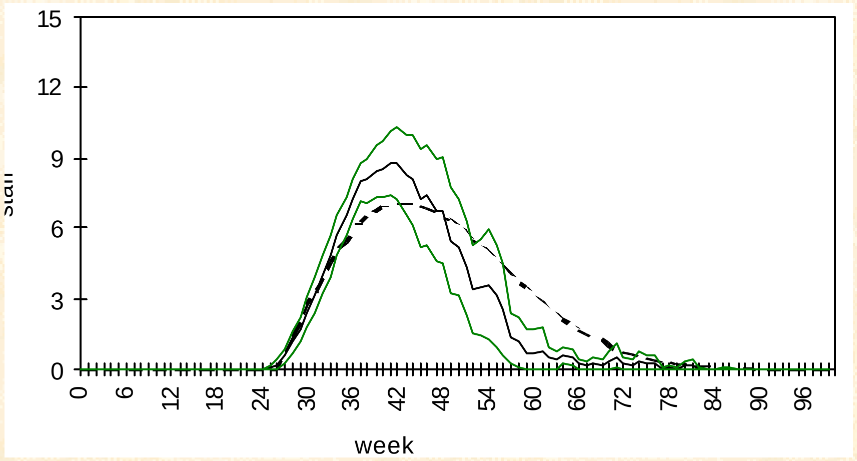
Attribute	Model	Conf. 95%	SEL
Final Size	116 KLOC	+/- 20	116
Effort	500 PW	+/- 60	600
Delivery	78 W	+/- 3	63
Productivity	5.8 LOC/p-hour	+/- 1.8	5.3
Rework %	17 %	+/- 3%	/
Defect Density	0.9 Defects/KLOC	+/- 0.3	/
Average Staff	6.5 P	+/- 1	9.5

Stable Requirements – Comparison with SEL



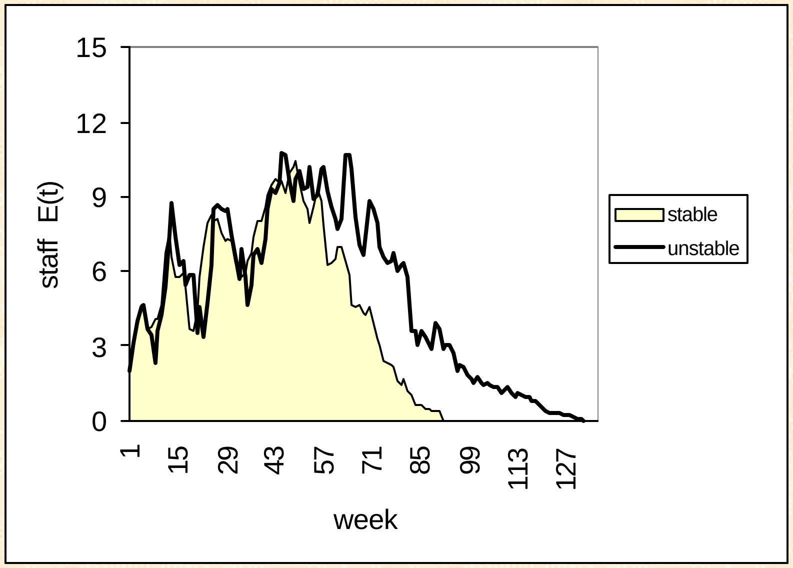


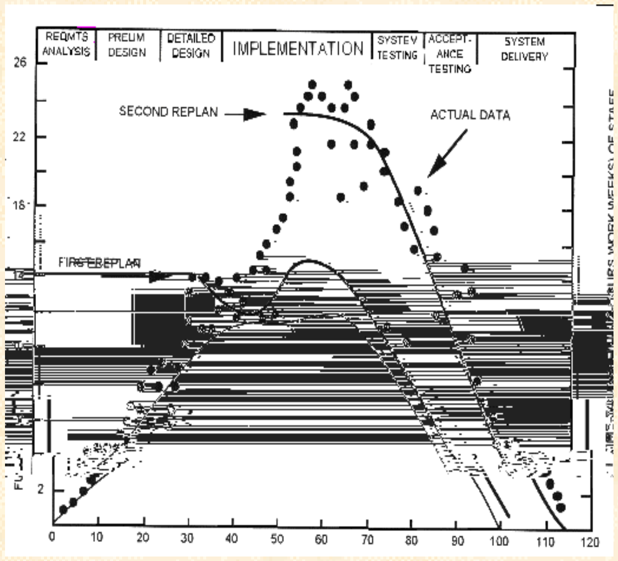
project staff profile



activity staff profile

Effects of Instability on the Staffing Profile





Simulation Results

A real project

Conclusions

Simulation results demonstrate the capability of the described model of

- **reproducing empirically-known facts**
- **being adopted as tool to test process assumptions**

The suggested approach allows high model flexibility and reusability:

- **easy extension to other process paradigms and easy hierarchical modelling of activities's details;**
- **adaptable to the maturity of the target environment, and updatable to follow its evolution (CMM, QIP).**